# AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

RAYMOND OLNEY, M. E., A. E., Editor

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## Consult "the Other Fellow" First

SOMEONE once remarked, in effect, that we don't learn anything from history. This apparently is not only true of nations but of individuals and groups of individuals

Agricultural engineering involves a wider variety of engineering problems than that of any other branch of the profession. For this reason the agricultural engineer must have at least a working knowledge of many subjects which are treated as specialties by some engineers. It stands to reason, therefore, that not infrequently the agricultural engineer in attempting to solve one of his own problems, which involves features belonging to one of the specialized lines, is not possessed of the most thorough and up-to-date knowledge in this specialty. As a consequence the results are not always as satisfactory as could be desired for sooner or later the shortcomings are almost certain to be discovered.

If it could be arranged, it would seem as though a little closer cooperation between the American Society of Agricultural Engineers as a body and other engineering societies specializing in subjects which are more or less involved in agricultural engineering, would be highly desirable and profitable to the A. S. A. E. and American agriculture as well. The same thing would doubtless hold true when applied to the individual members of the Society.

It goes without saying that in designing new farm machines, improving old ones, installing lighting plants, water or heating systems, etc., that there are certain problems involved which specialty engineers have thoroughly mastered, although they would not be entirely competent to apply their principles to such equipment for farm use.

In attacking these problems, therefore, the agricultural engineer might do well to obtain the last word from such specialists and then make his own application. The same would hold true in making tests of present equipment. Numerous instances could be cited where consulting "the other fellow" first would have assured more satisfactory results.

ARNOLD P. YERKES

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## Tribute to an Industry

JUST A WORD of commendation for an industry which has delivered a valuable service in the face of many difficulties and which, though its ranks are thinned, is going on today with no thought of defeat but only of service and success. I refer to the farm implement industry.

During the World War, when greed held full sway in many industries, what do we find of farm machinery—almost the same identical quality of product with a slight percentage of increase in price, which a recent investigation showed was not equal to the increase in wages paid to workers. Other industries raised prices to an unheard of level because times were good and money was easy to get. Then, when the lean time came, they were prepared to lose for a few years.

This might have been a wise policy for the implement industry, but alas it was not followed. When the lean time came, this industry was manufacturing from war-priced materials and a rise in selling price was necessary. This brought out hasty conclusions from many and led to investigations and threats of boycott. These investigations proved one thing at least, and that was that the profits in this industry were no greater during the period of inflation than they were before. If the selling price was just before the war, it has been fair during and since that time. Those stalwart organizations which have weathered the deflation period are advertising today with the same forward look of better days. These institutions have come to be almost as necessary to American farming as is soil and seed. A leader in an agricultural college recently remarked that the loss of service due to exposure, to weather, to improper adjustment, and lubrication is much greater than the first cost to which he was objecting. He has found that "American farm machinery has made possible American agriculture."

American agriculture is beginning to revive from the rough treatment it has received, and when it begins to look about, it will find a brother convalescent in the implement industry.

The farmer who talked of boycotts, etc., has learned that his dollar will buy as much if not more of 1924 machinery than of any other product. The tendency on the farms today is more machinery and less men. May the implement industry be able to develop the machines so much needed to increase man's productive ability and to keep up his standard of living.

J. C. WOOLEY

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## Filling the Gap

IT IS NOT an uncommon thing these days to hear people—not those on the farms or those conversant with actual farm conditions—bewail the fact that so many people are leaving the farm for the city. It is undoubtedly true that people who have left the farm during the past two or three years now number up into the millions. At the same time, our population is increasing in terms of millions. "What are we going to do for food and clothing if the exodus from the farm to the city continues and our population also continues to increase?" the alarmed ones ask.

The agricultural engineer knows what we are going to do; he is not alarmed at the rate people are leaving the farm or at the rate our population is increasing. From the agricultural engineer's point of view there are now too many people on farms—people who have made farming an occupation rather than a business. "Let the people leave the farm," says the agricultural engineer; "it won't be serious if a few million more leave, because we will fill up the gaps with engineering."

The exodus from the farm and the increased population is not a serious thing so far as the farmer is concerned. The situation will do two things: It will cut down the volume of farm production to some extent, temporarily at least, and will increase the demand for products from the farm. Both will be important factors and will increase the price of what the farmer has to sell.

Moreover, people who are leaving the farm are, for the most part, those who are not successful farmers; in other words, men who are real honest-to-goodness farmers, who are making farming a study and a business, and not merely an occupation, are not leaving the farm. It is a case of the survival of the fittest, and it is one of the most encouraging signs for the future progress and prosperity of American agriculture that could be wished for.

Fewer people on the farm will make necessary a more rapid and more extensive application of engineering to agriculture—in the shape of mechanical power, labor-saving equipment of all kinds, improved buildings, drainage; in fact, all those things of an engineering nature which tend to lower production costs, increase the productive capacity of the individual worker, and otherwise put the agricultural industry on a more efficient and economical basis.

# What the Meetings Committee Says About The Annual Meeting Program

WOULDN'T you—who are planning on attending the annual meeting of the American Society of Agricultural Engineers to be held at Lincoln, Nebraska, June 18, 19, and 20, 1924—like to know what each member of the Meetings Committee has to say in regard to that part of the program for which he is responsible? The division chairmen who constitute the membership of the Meetings Committee were asked to make a statement regarding their respective programs. The statements follow, and will be of unusual interest to those who are looking forward to the meeting.

President McCrory, who is ex-officio member of the Meetings Committee and in charge of the banquet program, makes no statement. Usually it is the policy to keep the banquet program secret until it is presented, and apparently that policy will be carried out again this year. All we can say about the banquet is that, judging from the amount of time and thought that has been put on it, there will be no disappointments.

## Farm Power and Machinery Program

By F. A. Wirt

EVERY farmer in the United States is interested in the farm power and machinery program to be given at the A. S. A. E. meeting at Lincoln, in June. This country has grown and prospered as it has made more effective use of farm machinery. With conditions existing as they are today in the agriculture of the United States and foreign nations, it is very important that the farmers of the country be thoroughly familiar with the ways and means of reducing the cost of production.

To increase his profits the farmer must get more for what he sells or produce at less cost. The latter offers the greater opportunity, a fact readily admitted by the most skeptical after a serious consideration of the problems of the farmers.

The theme of the farm power and machinery program is "The Influence of Farm Power and Machinery on Economic Production, with Special Reference to the Corn Crop." It was found impossible to apply such a broad theme to agriculture as a whole, so it was decided to discuss this very important relation between farm power and machinery on the one hand and economical production on the other, with special reference to the corn crop.

The first feature on the program will be an address, entitled "Power, Machinery and Production," by C. D. Kinsman, of the U. S. Department of Agriculture. This address will give the results of a nation-wide study by the U. S. Department of Agriculture on the power requirements of different crops, especially corn. The values of this address alone can best be appreciated when it is known that the number of hours necessary to produce a bushel of corn varies many hundred per cent.

Another address, while not particularly applicable to the corn crop, gives promise of being unusually interesting because the speaker, Prof. L. J. Fletcher, of the department of agricultural engineering at the University of California, has for his subject "What the California Farmer Confidentially Thinks About Tractor Design." Confidential opinions are usually interesting, if not intriguing. Individual men in the industry of manufacturing as well as in the industry of farming are looking forward to what the California farmers have to say.

"The Manless Plow," by Prof. J. B. Davidson, of Iowa State College, will be a description of a plow which requires neither man nor boy in its operation after the outfit is started to work in the field. We cannot say that the idea is not practicable for the same criticism has been levelled against each and every labor-saving machine ever introduced. It is understood that pictures of the outfit will be shown to men attending the meeting.

"Motorizing the Corn Crop in Ohio," by Prof. G. W. McCuen, of the department of agricultural engineering, Ohio State University, will be of much value on the cost of producing corn in that state, from which so many presidents come. This address will be based on careful experimental work by one of the best known agricultural engineers in the country. Much food for thought will be offered in this address.

In Kansas they raise corn planted on the surface with corn planters and planted in furrows by listers, two methods which have certain advantages and disadvantages which adapt the methods to different sections of the country. Prof. W. E. Grimes of the department of agricultural economics of the Kansas State Agricultural College, Manhattan, Kansas, has been a student of this subject for many years, and will have information which will help farmers in semi-humid districts to produce corn with greater efficiency.

There is hardly a farmer living who is not interested directly or indirectly in knowing how one thousand acres of corn can be grown efficiently on one farm. An address on this subject will be presented by E. R. Wiggins, agricultural engineering editor of "Better Farming." The slides showing the machinery and methods used on this farm will be an agreeable surprise. The subject promises to be a treat for all those in attendance.

"Cutting Silage in the Field or at the Silo" is a live topic in many sections of the country, for within recent years a number of machines have been put on the market for the purpose of cutting silage in the field rather than at the silo. Prof. J. D. Parsons, department of agricultural engineering, University of Nebraska, will discuss this controversial subject.

"The Corn Picker in Profitable Corn Production" is the subject of an address that should prove of unusual interest. In 1923 hundreds of farmers who wished to buy corn pickers were unable to do so. There has been a great movement toward the adaption of the corn picker in certain areas. The subject will be presented by C. O. Aspinwall of the International Harvester Company.

Bert C. Danley, a progressive Nebraska farmer, will present a paper on the efficient use of horses as motive power in the production of field crops.

## The Reclamation Program

By John Swenehart

THE subject of land reclamation possesses unusual interest at the present time. It is one in which the nation at large is interested, but with which the agricultural engineer is more intimately concerned. All phases of the subject of reclamation will be discussed at the Lincoln meeting of the Society, including irrigation, drainage, land clearing, reforestation, and the prevention of soil erosion. The reclamation program will be opened by a paper by Geo. S. Knapp, state irrigation commissioner of Kansas, on the irrigation problems in that state, and will deal specifically with pumping irrigtaion. Mr. Knapp's paper will be followed by a discussion led by Prof. S. H. Beckett, professor of irrigation practices of the University of California.

N. A. Kessler, land clearing specialist of the Michigan Agricultural College, will present a paper on reclamation and forestry with particular emphasis on the relation between the clearing of cutover land and the development of a forestry program. Mr. Kessler has been both a forester and a land reclamation engineer and is now working largely

(Continued on page 135.)

# Program of 18th Annual A. S. A. E. Meeting

JUNE 17.—Reclamation tour of southeastern Nebraska; tractor testing (belt and drawbar) demonstration; excursion to the agronomy farm of the University of Nebraska; meeting of the Advisory Committee of the College Division; Council meetings.

## First Day—June 18

### GENERAL SESSIONS

2:00 P. M. Introductory Remarks: O. W. Sjogren, chairman, Committee on Local Arrangements
President's Annual Address: S. H. McCrory, chief, division of agricultural engineering, Bureau of Public Roads, U. S. Department of Agriculture
ADDRESS: H. J. Hirshheimer, president, National Association of Farm Equipment Manufacturers, and president, La Crosse Plow Company
8:00 P. M. ANNUAL BUSINESS MEETING

### FARM POWER AND MACHINERY PROGRAM

#### MORNING SESSION—9:00 A. M.

PAPER: "Power, Machinery and Production." (Results of U. S. D. A. nation-wide study on power requirements of different crops, especially corn.) C. D. Kinsman, division of agricultural engineering, U. S. Department of Agriculture
PAPER: "What California Farmers Confidentially Think About Tractor Design"—L. J. Fletcher, associate professor of agricultural engineering, University of California.
PAPER: "The Manless Plow"—J. B. Davidson, professor of agricultural engineering, Iowa State College
PAPER: "Motorizing the Corn Crop in Ohio"—G. W. McCuen, professor of agricultural engineering, Ohio State University
PAPER: "Growing 1000 Acres of Corn on the Hawthorn Farm in Illinois"—E. R. Wiggins, agricultural engineering editor, "Better Farming".

#### AFTERNOON SESSION—3:00 P. M.

PAPER: "Economical Production of Corn in Kansas"—W. E Grimes, professor of agricultural economics, Kansas State Agricultural College
PAPER: "Cutting Silage in the Field or at the Silo"—J. D. Parsons, department of agricultural engineering, University of Nebraska
PAPER: "The Corn Picker in Profitable Corn Production"—C. O. Aspenwall, International Harvester Co.
PAPER: "The Growing of Corn With Horse as Motive Power" —Bert C. Danly, farmer, Axtell, Neb.

### RECLAMATION PROGRAM

#### MORNING SESSION—9:00 A. M.

PAPER: "The Irrigation Problem in Kansas"—Geo. S. Knapp, state irrigation commissioner of Kansas
Discussion—S. H. Beckett, professor of irrigation practice, University of California
PAPER: "The Relation Between Clearing Cut-Over Land and the Development of a Forestry Program"—N. A. Kessler, land clearing specialist, Michigan Agricultural College
REPORT: Committee on Drainage—J. R. Haswell, extension agricultural engineer, Pennsylvania State College, chairman

#### AFTERNOON SESSION—3:00 P. M,

PAPER: "New Developments in Salvaged War Explosives"—W. A. Rowlands, land clearing section, department of agricultural engineering, University of Wisconsin
REPORT: Committee on Land Clearing—L. F. Livingston, land clearing specialist, Michigan Agricultural College, chairman
REPORT: Committee on Land Settlement—Wallace Ashby, agricultural engineer, Duluth and Iron Range Railroad, chairman
REPORT: Committee on Soil Erosion—E. W. Lehmann, professor of farm mechanics, University of Illinois, chairman

## Second Day—June 19

### GENERAL SESSIONS

2:00 P. M. Address: "Reclamation and Recreation"—(speaker not yet selected.)
7:00 P. M. ANNUAL BANQUET

### RURAL ELECTRIFICATION PROGRAM

#### MORNING SESSION—9:00 A. M.

PAPER: "Some Research Features Involved in the Application of Electricity to Agriculture"—R. W. Trullinger, specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture
Discussion—L. J. Fletcher, University of California
M. L. Nichols, Alabama Polytechnic Institute
E. A. Stewart, University of Minnesota
H. B. Walker, Kansas State Agricultural College
J. B. Davidson, Iowa State College

PAPER: "Electricity in Agriculture Abroad"—P. A. Lundquist, chief, electrical equipment division, U. S. Department of Commerce
REPORT: Committee on Rural Power Lines—C. A. Atherton, engineer, National Lamp Works (General Electric Company), chairman
REPORT: Committee on Unit Farm Electric Plants—L. S. Keilholtz, chief engineer, Delco-Light Co.

#### AFTERNOON SESSION—3:00 P. M.

PAPER: "The Relation of Water Power to Electrical Development"—G. C. Neff, general manager, Wisconsin River Power Company
PAPER: "Making Electrical Contact With the Farmer"—J. P. Fairbanks and E. J. Stirniman, division of agricultural engineering, University of California.
PAPER: "The National Farm Power Survey"—C. D. Kinsman, division of agricultural engineering, U. S. Department of Agriculture

### FARM STRUCTURES PROGRAM

#### MORNING SESSION—9:00 A. M.

PAPER: "To What Extent May Farm Houses Be Standardized" —Walter G. Ward, extension architect, Kansas State Agricultural College
PAPER: "The Spacing of Posts in Barns and Feeding Sheds as Affected by the Turning Radius of Various Vehicles"—Erwin K. Young, Ohio State University
REPORT: Committee on Farm Building Ventilation—M. A. R. Kelley, agricultural engineer, U. S. Department of Agriculture, chairman

#### AFTERNOON SESSION—3:00 P. M.

REPORT: Committee on Farm Building Equipment—D. G. Carter, professor of agricultural engineering, University of Arkansas, chairman
REPORT: Committee on Farm Building Design—W. A. Foster, professor of agricultural engineering, University of Georgia chairman
REPORT: Committee on Farm Sanitation—H. B. Walker, professor of agricultural engineering, Kansas State Agricultural College, chairman
REPORT: Committee on Farm Home Equipment—E. A. Stewart, associate professor of agricultural physics, University of Minnesota, chairman
REPORT: Committee on Farm Storage—K. J. T. Ekblaw, agricultural engineer, Portland Cement Association, chairman

## Third Day—June 20

### COLLEGE DIVISION PROGRAM

#### MORNING SESSION—9:00 A. M.

PAPER: "The Fundamentals of Research"—Wm. L. De Baufre, chairman, mechanical engineering department, University of Nebraska.
Discussion—J. B. Davidson, professor of agricultural engineering, Iowa State College
REPORT: Committee on Research of the College Division—R. W. Trullinger, chairman
REPORT: Advisory Committee of the College Division—D. Scoates, chairman
REPORT: Committee on Cooperative Relations, H. B. Walker, chairman
REPORT: Committee on Student Branches—J. B. Davidson, chairman
REPORT: Committee on Standardization of Blue Print Service —F. W. Ives, chairman

#### AFTERNOON SESSION—2:00 P. M.

PAPER: "Thought Processes and How We Learn"—Dr. William Elmer Sealock, dean of the teachers college and professor of history and principles of education, University of Nebraska
Discussion: F. W. Ives, professor of agricultural engineering, Ohio State University
REPORT: Committee on Teaching Methods—C. O. Reed, chairman
REPORT: Committee on Standardization of Courses—C. W. Smith
REPORT: Committee on the Advancement of Agricultural Engineering Education—F. W. Ives, chairman
REPORT: Committee on Aims and Objectives of the Agricultural Engineering Curriculum—J. B. Davidson, chairman

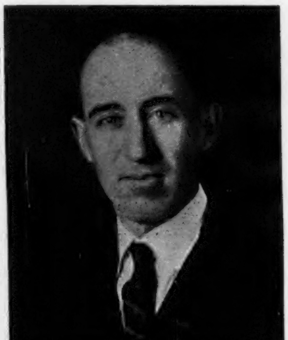
#### EVENING SESSION—8:00 P. M.

PAPER: "Aims and Objectives of Agricultural Engineering Extension"—R. L. Patty, extension agricultural engineer, South Dakota State College
REPORT: Committee on Agricultural Engineering Extension—H. H. Sunderlin, Iowa State College
DISCUSSION: "Pertinent Field Problems"—Agricultural engineering extension workers
Demonstration and inspection of Nebraska system of keeping office extension records—I. D. Wood, in charge

# Utilization of Electricity in Agriculture

**By E. A. Stewart**

Mem. A. S. A. E. Associate Professor of Agricultural Physics, Division of Agricultural Engineering, University of Minnesota



E. A. STEWART
Director of Project No. 17

NOTE: This article describes the progress being made in developing the fully electrified rural community at Red Wing Minnesota, which is the first of its kind to be established in this country; it is known as Project No. 17 and is under the immediate supervision of Prof. Stewart. This and similar projects that are being gotten under way in other states are being watched with intense interest by all who are interested in the application of electricity to agriculture. This method of approach to the solution of the various problems involved in supplying electric service to farm communities is highly commendable, to say the least. Its fundamental purpose is to insure that this new development will proceed along sound economic and engineering lines.

THE object of Project No. 17 is to determine whether central station companies can extend electric service to farms on a basis satisfactory to both the farmer and the utility. To ascertain the desired facts, there is being created near Red Wing, Minnesota, a fully electrified rural community, consisting of a rural line a little more than six miles in length serving a number of farms of varied character, constituting in effect a big practical laboratory for experimental purposes.

Electricity is now being used on about 50,000 American farms. In a comparatively few instances it has been brought to the farm for power purposes, such as pumping water for irrigation, but on the vast majority of farms already reached with electric service the farmer uses electricity only for lighting and a few inconsequential power purposes. The average rural consumer uses less electricity than does the city residence consumer; this in spite of the fact that it would seem that the farm would offer many more possibilities for electric power service than the city home.

It does not cost much to generate electrical energy. The larger part of the cost in the business of furnishing electric service is in distribution. Even in the cities where there are from 30 to 200 consumers to a mile of line, the investment in distribution far exceeds the investment in generation. In the country there is an average of not more than three consumers to a mile of line, so it will readily be seen that here the cost of distribution is even more in excess of the cost of generation.
the cost of generation.

The cost of electricity to the consumer is made up of two items, namely, the cost of producing it and the cost of delivering it. The cost of distribution consists of interest on the investment in transmission and distribution lines, transformers, protective devices, etc., and also cost of maintenance, depreciation, insurance, taxes and of line and transformer losses. On a mile of city line these distribution costs are divided among many consumers. On a mile of rural line there is an average of not more than three consumers among whom to divide these costs.

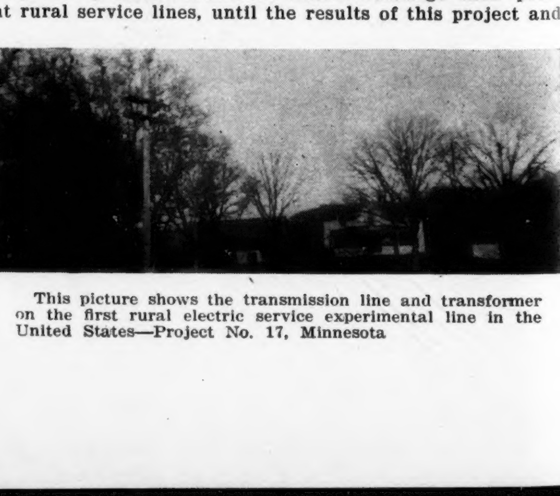
A study of the rural situation makes it apparent that the costs of the rural electricity to the consumer is many times greater than the actual cost of generating that electricity. Even if electricity could be generated free of charge for the farmers, only a minor item of the total expense would be eliminated.

A comprehensive survey in Illinois and Indiana shows that the cost of reaching the farmer with electric service is approximately $8.75 per consumer per month, including no cost for generation. All studies of rural electric service over a period of years makes it apparent that the service charge to reach the farmer in any average rural community must be from $5.00 to $8.00 per month per customer, even with generating costs excluded. The farmer should not be deluded into thinking that the development of electricity by water power in large quantities has any material bearing on the problem of reaching him with electric service. Even if electicity could be generated by water power for nothing, which is not the case, it would have little bearing on the cost of electricity to the farmer, for, as pointed out, the big cost in rural electrification is not in generation but in distribution.

Despite these unavoidable high costs of distribution there does seem, however, to be a way to give the farmer electric service at a cost acceptable and advantageous to him. It should be emphasized, however, that there is no way for the farmer to obtain electric service from an electric light and power company at a low cost, if he continues to be a small consumer. The cost of reaching the farmer with electric service should be a separate item of charge. Then the charge for the actual electric energy should be low. After the farmer pays the cost of reaching him with electric service, if he then uses very little electric energy, his cost per kilowatt-hour will be high, but if he becomes a considerable consumer, the cost of reaching him does not increase and the actual kilowatt-hour cost drops to a very reasonable figure. Under these circumstances the farmer may make many uses of electricity at a cost that is less than that for other forms of power. He will be able to operate his washing machine at a cost of one cent per week; he may grind his feed at a cost of one cent per bushel for power; he may pump his water, milk his cows, saw wood, run a cream separator, light the hen house, and perhaps even plow his land by electricity. In fact it seems quite possible that the farmer may make electricity an actual income producer. Thus electric service instead of being a drain on his pocketbook may increase his income and, in addition, make life more enjoyable and remove from the farmer and his wife many of those hardships they now endure.

Just how the farmer is to use this electricity so as to make it a profitable acquisition we are not, as yet, in a position to advise. The purpose of Project No. 17, entitled "The Utilization of Electricity in Agriculture," is to determine these facts so that we will be in a position to give the farmer definite information. Many problems are involved, which must be solved before the application of electricity to agriculture will be a success.

Farmers should not attempt to have their communities served with electric lines, nor should the public utility companies promote additional lines or enlarge their present rural service lines, until the results of this project and



This picture shows the transmission line and transformer on the first rural electric service experimental line in the United States—Project No. 17, Minnesota

those of a similar nature in other states are determined. The farmer has all too frequently been the loser because of buying costly equipment that he was not in a position to use or that was not suited to his use. No one is in a position today to advise the farmer as to what electrically driven equipment can be used with profit to himself, nor is anyone in a position to warn him against the purchase of this or that piece of equipment as being impractical. However, Project No. 17 will be the means of securing definite facts so that the farmer can obtain accurate information and advice. Until these facts are available it is deemed expedient to advise against further rural electrification. Our interests are in the farmer and we consider it most inadvisable for him to invest his money in rural electrification and purchase of equipment until necessary facts have definitely been ascertained.

Project No. 17 is being conducted by the University of Minnesota and is under the direct supervision of the writer. The University is assisted in the project by the Northern States Power Company, the state Committee on the Relation of Electricity to Agriculture, consisting of James F. Reed, president of the Minnesota Farm Bureau Federation, chairman; W. C. Coffey, dean of the Minnesota College of Agriculture; Herman Schmechel, farmer, Fairfax, Minn.; Isaac Emerson, farmer, West Concord, Minn.; W. J. Bryan, farmer, Red Wing, Minn.; Charles F. Stuart, assistant to vice-president and general manager, Northern States Power Company, Minneapolis, Minn.; C. S. Kennedy, Ottertail Power Company, Fergus Falls, Minn.; the national Committee on the Relation of Electricity to Agriculture, and twenty-five or more companies manufacturing electric equipment and farm machinery. It should be mentioned too that the farmers also, who are now receiving service from the Red Wing experimental line, are giving most valuable cooperation. The Red Wing line was built by the Northern States Power Company. The farms served are being equipped with motors, electrical appliances, farm

THE COMMITTEE BEHIND PROJECT No. 17

This is the Minnesota State Committee on the Relation of Electricity to Agriculture that is directing Project No. 17. From left to right: Isaac Emerson, W. J. Bryan, C. F. Stuart, W. C. Coffey, Herman Schmechel, C. S. Kennedy, J. F. Reed, chairman

machinery, barn equipment, etc., to utilize electricity in all possible ways. Electricity will be used for washing clothes, pumping water, ironing clothes, hatching and brooding chicks, cleaning, cooking, washing dishes, feed grinding, milking, sawing wood, cutting ensilage, refrigeration, hoisting hay, shredding corn, threshing grain, and possibly for plowing. Records will be kept of the various types of work that is done by electricity to determine how this electricity should be used and when it should be used.

The solution of this problem is so important that many other states are now following the lead of Minnesota and organizing projects along similar lines to help solve the problem of reaching the American farm with electric service.

# Experiments in Plowing Cut Over Land*

DURING the summer (1923) arrangements were made to conduct a series of experiments on the effectiveness and relative efficiency of different types of tractors and breaking plows on rough hardwood land as compared to the usual team and hand plow breaking. The points considered were.

(a) Comparison of tractors of wheel and tracklaying type, their total time, actual running time, idle time, and reasons

(b) The consumption of time, fuel and oil per acre.

(c) The efficiency of lugs, extension rims and traction methods.

(d) The type and size of plows best adapted for each particular soil condition and for each tractor.

(e) The quality of plowing done by each plow.

(f) The comparison in cost and efficiency of one man plows and those requiring an extra man for their operation and with the usual method of team plowing.

In co-operation with D. L. McMillan, superintendent of the upper peninsula experiment station (Michigan) a field was selected which had been cleared during 1922. It was typical rough hardwood land, with possibly more than the average of cradle knolls and general roughness. This field was laid off into five-acre plots, and as far as possible each outfit was required to complete a five-acre plot. Daily records showing each round were kept with as full notes and pictures as possible. Some of the plots were plowed during extreme dry weather and the rest while the ground was in good plowing condition. The test is being completed by keeping cost data on the fitting of each of these plots into a seedbed as nearly equal as possible. While the complete data and records are not yet available, some very definite conclusions were evident:

1. It was found that even with a small two-plow tractor, single-bottom breakers were available that did much better and cheaper breaking than was possible with the ordinary team methods.

2. It was evident that for a good quality of breaking in these conditions, a plow must have:

(a) A flexible and long hitch between plow and tractor;

(b) A wide and long moldboard with a quick curve to turn under trash and sod;

(c) A long landside to prevent it from being pushed out in knolls;

(d) A standing knife coulter with a point of its own so the furrow slice was completely cut before reaching the moldboard;

(e) Plenty of clearance in the throat to allow sod, roots and trash to be turned without clogging;

(f) Only one bottom can be successfully pulled and do a good job of breaking, regardless of size of tractor; and

(g) All breaking plows should have a moldboard extension.

3. Tractor breaking plows leave the ground more completely turned over and levelled, and in better shape for fitting afterwards.

4. Any wheel type tractor must have more than standard wheel equipment to be able to break through this type of new land.

5. The condition of the soil will make as much as $2 to $3 difference in the cost of breaking per acre. During extreme dry soil conditions this much variation was shown with the same equipment, compared to cost with soil moist.

6. Tracklaying tractors have a certain advantage in getting over this extremely rough ground, with a minimum of lost and

(Continued on page 138)

*From 1923 report, Committee on Land Clearing.

# Comparative Tests of Roof Ventilators*

By Walter G. Ward

Mem. A. S. A. E. Extension Architect, Kansas Agricultural College

THIS discussion is based on two papers presented at meetings of the American Society of Heating and Ventilating Engineers; one was prepared by H. L. Dryden, W. F. Stutz and R. H. Heald at the U. S. Bureau of Standards, Washington, and the other by J. P. Calderwood, A. J. Mack and C. J. Bradley at the engineering equipment station of the Kansas State Agricultural College.

The tests conducted by the U. S. Bureau of Standards were made during the summer of 1920[1]. About fifty 16-inch ventilators were used in the study. The tests were limited to questions concerning the volume of air exhausted per minute by the ventilators. While many factors affect the performance of a ventilator, only the two most important were studied in the tests. These were (1) the difference in temperature between the air in the room and the air outside and (2) the velocity of the wind blowing across the top of the ventilator.

The design of a ventilator affects the amount of air exhausted under a given temperature difference only in so far as more or less resistance is offered to the flow of air. The tests were conducted by comparing the volume of air passing through a ventilator and through an open pipe of the same size and with the pressure constant. Ratings were made on the basis of the open pipe as 100. It is apparent that 100 is the maximum obtainable for this factor, and is referred to as the resistance rating.

The exhaust due to the wind depends primarily upon the design of the ventilator. In the tests made to determine the ratings of the several ventilators in this regard, the temperature at the entrance and exhaust were maintained the same to obviate any chimney action. Measurements were made of the volume of air exhausted per minute by the ventilators at wind speeds of four, eight and twelve miles per hour. For comparison, wind ratings were obtained by expressing the volume exhausted by a ventilator as a percentage of the volume exhausted through an open pipe of the same size, in the same time, at the same wind speed. Therefore, the wind rating of the open pipe is 100 at all wind speeds, while the ventilators might have ratings either higher or lower. The best ventilators tested showed a wind rating of about 150, while others were below 100.

The U. S. Bureau of Standards classifies the ventilators under two types—stationary and rotary. A point established by the tests on the stationary ventilators is that the width of the band has a marked influence on the efficiency of a ventilator. As an example, one simple stationary ventilator had a wind rating of 96 and a resistance rating of 88. The band was lengthened so as to extend a little below the lip, and the wind rating was increased to 130. The best exhaust from the stationary type of ventilators was secured from some of those having very simple construction.

In the rotary type of ventilators a wide range was apparent in both the wind rating and the resistance rating. One of the most efficient of the ventilators showed a wind rating of 150 and a resistance rating of 95.

It was found that some of the ventilators which have a passage through which the outside air passes were considerably less efficient than when the passages were closed.

The paper concludes with an emphasis on two points. The first is that no general statement can be made as to the relative merits of rotary and stationary ventilators, as their performance depends on the particular models. It is possible to build a good stationary ventilator as well as a good rotary ventilator, and there are poor ones of each type.

The second point is that the most effective way of obtaining a large volume of air exhaust is by making use of the region of low pressure at the back of a properly designed obstacle. It is best not to allow the outside air to enter the ventilator.

The tests[2] conducted at the Kansas Engineering Experiment Station were begun in 1919. Later their scope was enlarged and the equipment was made more complete. In addition to the classification of stationary and rotary ventilators as used by the U. S. Bureau of Standards, each type was subdivided into two classes referred to as plain and siphoning. The four types were classed as plain stationary, siphoning stationary, plain rotary and siphoning rotary. All of the ventilators tested were of the same commercial size, having a base diameter of ten inches.

It was recognized by the engineers conducting the tests that numerous factors influence the practical performance of a ventilator. The scope of this investigation was limited to the securing of data on the performance of the wind in inducing a current of air through the ventilator and to ascertain, if possible, what principles of design should be incorporated to secure the most efficient ventilator.

The accompanying tables show the results of the tests.

TABLE 1.—RESULTS OF TESTS SHOWING THE VELOCITY IN FEET PER MINUTE INDUCED THROUGH SEVEN DIFFERENT PLAIN STATIONARY VENTILATORS

| Velocity of wind in miles per hour | No. of Ventilator | Velocity induced through ventilator, feet per minute — Ventilator Designation 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 4 | 145 | 185 | 266 | 148 | 185 | 142 | 133 | 160 |
| 8 | 241 | 287 | 355 | 257 | 287 | 238 | 242 | 267 |
| 12 | 337 | 390 | 446 | 366 | 390 | 334 | 350 | 375 |

TABLE 2.—RESULTS OF TESTS SHOWING THE VELOCITY IN FEET PER MINUTE INDUCED THROUGH SIX STATIONARY SIPHONING VENTILATORS

| Velocity of wind in miles per hour | No. of Ventilator | Velocity induced through ventilator, feet per minute — Ventilator Designation 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 4 | 145 | 162 | 157 | 226 | 189 | 205 | 206 |
| 8 | 241 | 304 | 292 | 404 | 315 | 332 | 369 |
| 12 | 337 | 446 | 426 | 583 | 440 | 458 | 532 |

TABLE 3.—RESULTS OF TESTS SHOWING THE VELOCITY IN FEET PER MINUTE INDUCED THROUGH FOUR PLAIN ROTARY VENTILATORS

| Velocity of wind in miles per hour | No. of Ventilator | Velocity induced through ventilator, feet per minute — Ventilator Designation 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| 4 | 145 | 208 | 192 | 191 | 202 |
| 8 | 241 | 346 | 348 | 354 | 341 |
| 12 | 337 | 484 | 505 | 518 | 480 |

TABLE 4.—RESULTS OF TESTS SHOWING THE VELOCITY IN FEET PER MINUTE INDUCED THROUGH FIVE ROTARY SIPHONING VENTILATORS

| Velocity of wind in miles per hour | No. of Ventilator | Velocity induced through ventilator, feet per minute — Ventilator Designation 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 4 | 145 | 257 | 192 | 222 | 217 | 204 |
| 8 | 241 | 479 | 370 | 387 | 410 | 393 |
| 12 | 337 | 702 | 548 | 553 | 606 | 582 |

TABLE 5.—RESULTS OF TESTS SHOWING THE AVERAGE VELOCITY IN FEET PER MINUTE INDUCED THROUGH THE VARIOUS TYPES OF VENTILATORS

| Velocity of wind in miles per hour | No. of Ventilator | Velocity induced through ventilator, feet per minute — Type of Ventilator: Plain Stationary | Siphoning Stationary | Plain Rotary | Rotary Siphoning |
|---|---|---|---|---|---|
| 4 | 145 | 168 | 191 | 198 | 218 |
| 8 | 241 | 273 | 326 | 348 | 408 |
| 12 | 337 | 379 | 461 | 497 | 598 |

*Seventeenth annual meeting paper.

[1]"Comparative Tests of Roof Ventilators", H. L. Dryden and W. F. Stutz. Journal American Society Heating and Ventilating Engineers, January, 1923.

TABLE 6.—RESULTS OF TESTS UPON AN EXPERIMENTAL VENTILATOR TO DETERMINE EFFECTIVE WIDTH OF STORM BAND

| Wind velocity in miles per hour | Velocity induced through ventilator, feet per minute | | | |
|---|---|---|---|---|
| | Width of storm band in inches | | | |
| | 17½ | 19 | 20 | 21 |
| 4 | 130 | 164 | 183 | 202 |
| 8 | 402 | 432 | 456 | 477 |
| 12 | 620 | 651 | 680 | 696 |

It will be noted that Table 5 gives the averages for the four types of ventilators tested.

The results of this test agree with those made by the U. S. Bureau of Standards in that no general statement could be made showing the superiority of one type over others, but that there are good and poor ventilators in each type. These tests show somewhat higher values for the wind rating than those reported by the Bureau of Standards. but this may be accounted for as the testing equipment was somewhat different.

The investigators found that some of the non-siphoning types of ventilators are as effective as some of those employing the siphoning principle. This fact led to an investigation to determine the effectiveness of the siphons. A number of siphon type ventilators were tested with the windward side of the ventilator closed, and in each instance the effectiveness of the ventilator was not decreased.

Table 6 shows the results obtained in testing a ventilator with a varying width of band. This indicates particularly that with low wind velocities the wider band is far more effective than a narrow one.

The paper emphasizes the importance of designing ventilators with ample areas for the outgoing gases.

The University of Minnesota has reported the results of tests[3] conducted on five types of ventilators. The ventilators were all 10 inches in diameter and the wind velocity was produced by a fan discharging through a 36-inch circular duct. The ventilators were placed 3 feet 10 inches from the outlets in such a position that the center of the head was nearly in the center of the duct. The best results were obtained by the so-called rotary siphon type of ventilator closely followed by the so-called plain stationary type. It is thought to be impossible to obtain uniform results from ventilators of the same class but that ventilators, even though similar, give entirely different results depending upon the dimensions and proportions.

[2] "Recent Tests on Automatic Ventilators", A. J. Mack and C. J. Bradley. Heating and Ventilating Magazine, April 1922, p. 36. (See also October 1921.) Journal American Society of Heating and Ventilating Engineers, Dec. 1920, Vol. 26, No. 9.

[3] "Comparative Tests of Roof Ventilators", F. B. Rowley, Journal American Society of Heating and Ventilating Engineers, Vol. 29, (1923) No. 1, pp. 9-13.

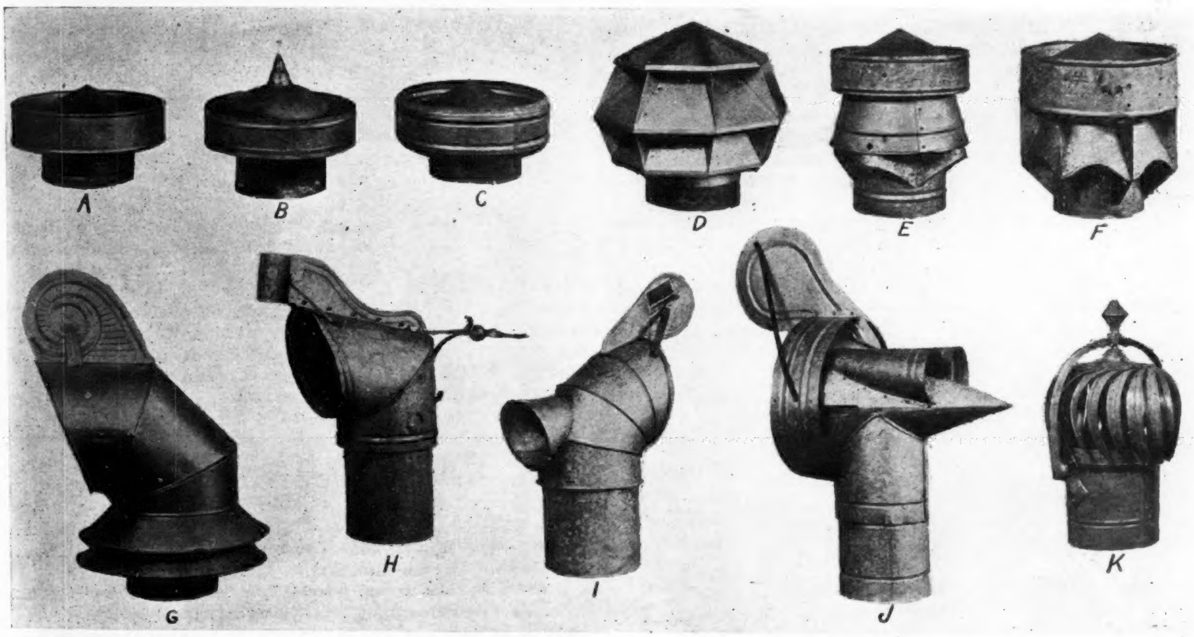
## Wants Data on Subsoil Plowing

Editor AGRICULTURAL ENGINEERING:

I HAVE been trying to secure some actual definite figures on cost and results of subsoil plowing, and it is surprising how little data there is on this subject. For years so-called agricultural authorities have been recommending subsoil plowing for hardpans and soils with stiff clay subsoils, although in recent years the tendency seems to be to question the general profitableness of this practice. It is easy enough to figure out on paper that loosening a refractory subsoil will so improve its physical condition that increased crops will result, but when one is faced with the responsibility of recommending the purchase of equipment for this purpose or is contemplating using his own money to purchase it, the situation assumes a different aspect. One then immediately wants to know:

1. On what types of subsoil is subsoiling effective in improving the physical condition and causing crop increase?
2. What types and depths of hardpan can be broken up by subsoiling?
3. What types of equipment are best suited for this work? What power should be used?
4. How frequently should stiff clay subsoils be subsoiled? How deeply?
5. What is the cost of subsoiling per acre (units of man hours, horse hours, tractor hours, and fuel and repairs and materials used should be given rather than dollars)? The cost will, of course, vary with the kind of subsoil and equipment used.
6. What increased crop yields are secured as a result of subsoiling? Of course, this will vary with different crops and subsoiling that might be profitable with one crop would not pay for others.
7. What I want to know is does subsoiling pay a profit, and if so under what conditions? Can some of the readers

(Continued on page 138)




A VARIETY OF TYPES OF AUTOMATIC VENTILATORS

A, B, C—plain stationary. D, E, F—stationary siphoning. G, H—plain rotary. I. J—rotary siphoning. K—turbine (rotary siphoning)

# Present Day Types of Farm Septic Tanks*

By R. C. Kelleher

Assoc. Mem. A. S. A. E. Assistant in Farm Mechanics, University of Illinois

THE modern types of far mseptic tanks have developed gradually from the cesspool. This development has been influenced to a certain extent by the rapid development of the municipal sewage disposal plant.

The cesspool was at one time a common means of sewage disposal, but it is not often used at present. Of the two types in use the leaching cesspool is the most common; the tight cesspool is not found so often.

The leaching cesspool consists of an excavated hole lined with some porous material such as stone or brick. It permits the liquid part of the sewage to find egress into the soil while the solid portion accumulates until the hole is filled. The leaching of the foul liquid into the soil endangers the farm water supply, and also the contents of the tank must be disposed of at frequent intervals. For these reasons the leaching cesspool has been almost universally condemned.

The tight cesspool is built thoroughly watertight so that the liquid as well as the solid portion of the sewage is retained. This makes it necessary to empty the tank at regular intervals. Sometimes in order to overcome frequent emptying an overflow pipe is provided thus allowing the foul liquid to escape into an open ditch. This condition is no better than that found in the leaching cesspool, so that he tight cesspool has also been condemned.

The first septic tanks were simply a modification of the tight cesspool, but they were constructed so as to provide conditions favorable to the growth of anaerobic bacteria which cause separation and liquefaction of the solid material in the sewage. Septic tanks built on this principle were first used about 1880. These septic or scum tanks consisted of a watertight chamber of suitable capacity through which the sewage flowed slowly. The inlets and outlets were suitably submerged to prevent disturbance of the floating scum, thus favoring bacterial growth.

About 1890 the cultivation or upward filtration tank was first used to digest raw sewage. It consisted of a small inlet chamber and a cultivation chamber which was filled with broken stones. The sewage passed downward through the inlet chamber and then upward through the stones in the cultivation chamber, escaping at the top by means of an overflow pipe. This method is no longer used to handle raw sewage from farm houses, but it has been modified in some instances and used to take care of the effluent from farm septic tanks.

A survey of the present day types of farm septic tanks show that the simple single-chamber tank and the two-chamber tank with automatic syphon are by far the most common. The following is a classification of the different types of tanks recommended by a number of state agricultural colleges, state boards of health and commercial concerns representing different sections of the United States:

| | |
|---|---|
| Simple single-chamber tank | 20 |
| Two-chamber tank with automatic syphon | 20 |
| Septic tank privy | 7 |
| Simple three-chamber tank | 5 |
| Simple two-chamber tank | 4 |
| Imhoff tank | 2 |
| Three-chamber tank with automatic syphon | 1 |
| Settling tank with upward sand filter and downward pebble filter | 1 |
| Total number represented in classification | 60 |

Most of these recommendations specified some means for disposal of the effluent from the tanks. Some of the recommendations did not specify a means for disposing of the effluent, but practically all of them considered this necessary. The recommendations specified for disposal of the tank effluent are given below:

| | |
|---|---|
| Drain tile laid with open joints | 30 |
| Line of tile in gravel trench | 4 |
| Intermittant sand filter | 2 |
| Leaching well | 1 |
| Bed of stones | 1 |
| Total number represented in classification | 38 |

The modern septic tank operates on practically the same principle as that of the original septic or scum tank. The capacity of the tank is such that the sewage will stand in it long enough for anaerobic bacteria to act on the digestible solids in the sewage and change them into liquid and gas The remaining solids settle to the bottom of the tank in the form of a sludge leaving the effluent considerably purified. Ordinarily the effluent from the tank is disposed of under conditions favorable to aerobic bacteria so that the resulting oxidation and nitrification still further purifies the effluent before it becomes a part of the soil water or of a stream.

The simple single-chamber tank is generally built rectangular in shape with submerged inlets and outlets or a system of baffles which eliminate agitation. This condition favors septic action and the consequent formation of a top scum; the baffles, however, prevent the scum from escaping undigested. The effluent from the tank is ordinarily run into a line of open-jointed underground tile or a filter bed of some kind. From this it seeps into the soil and the more or less intermittent discharge of the tank causes air to be drawn into the soil or filter material. This provides conditions favorable to the growth of aerobic bacteria which still further purifies the effluent.

The two-chamber tank with automatic syphon has a scum chamber similar to that of the simple tank and in addition a dosing chamber which is emptied intermittently by an outomatic syphon. The action in the scum chamber is the same as that in the simple tank, but the purification continues in the dosing chamber. The automatic syphon gives a more marked intermittant discharge than is found in the simple tank. This produces better aeration in the soil or filter material and thus improves the action of the aerobic bacteria.

In the simple two and three-chamber tanks the purification is carried one step further than it is in the simple single-chamber tank. The effluent from the first chamber of a multiple-chamber tank is partly purified when it enters the second chamber. Septic action again takes place causing the formation of a scum and the further liquefaction of solid matter. The scum in the second chamber is not as thick as that found in the preceding one and the effluent is somewhat clearer. In the three-chamber tank with automatic syphon the purification continues as the effluent passes from one chamber to another the same as it does in the simple three-chamber tank.

The Imhoff tank as used in large sewage disposal plants has been modified in a few cases and used for disposal of farm sewage. The tank is built deeper than an ordinary septic tank. A baffle board placed near the top retains the solids until they dissolve. The remaining solids fall through the baffle and settle at the bottom as sludge.

The septic tank privy, although not strictly a septic tank, consists of a water tight single-chamber tank built under an out-door privy. The tank is equipped with baffle boards and a line of open-jointed tile is connected to take care of the effluent. In operation one or two buckets of water is poured through the seats daily.

*From 1923 report, Committee on Farm Sanitation.

# Some Sewage Disposal Investigations*

By E. A. Stewart

Mem. A. S. A. E. Associate Professor of Agricultural Physics, University of Minnesota

THE division of agricultural engineering, University of Minnesota, has been carrying on experimental work in sewage disposal along three principal lines as follows:

(a) The design and construction of a homemade siphon that can be built at a lower cost than the cost of commercial types.

(b) The design of inlets to septic tanks, and the design of the tank to give a clear effluent.

(c) The design of proper methods of disposal of the effluent.

So far we have perfected a siphon that can be built at a cost of $10 to $12. This type of siphon is now in use and its details of construction will be given out as soon as it is given a thorough trial. So far its operation has been 100 per cent, but we desire to use it under other conditions.

The suspended solids that are carried out in sewage is a result of two conditions. One condition which increases the the amount of suspended solids is the type of inlet. The simple elbow inlet has not been satisfactory. Tests with this type of inlet show that the incoming sewage stirs up the sludge very much. These experiments were carried on in an experimental tank, which is shown in Fig. 1. This tank is made one-fourth regulation size. It has glass windows in the side for observation and for light. The inlets to the tank are arranged so that the four types of inlet may be used. The types are: (1) simple elbow; (2) elbow and tee with points of the tee turned sidewise; (3) baffle boards, and (4) current breaker chamber.

The sewage, when carried in through a simple elbow or behind a baffle board, produced a great deal of agitation in the tank. The sludge at the bottom was stirred up and carried away from the entering end of the tank. The sludge was very unevenly distributed over the bottom. The second and fourth methods gave very satisfactory results. The current breaker chamber is shown at the right in Fig. 1. The construction using a tee and an elbow is shown in Fig. 2. Several tanks have been constructed using these types of inlets, and they are giving good satisfaction. The double quarter bend and elbow are used where the soil pipe is used direct to the septic tank. The current breaker chamber is used where sewer tile is used from the house to the septic tank.

The design of the tank has also been given some attention. We are not ready as yet to announce conclusions. A middle chamber in the tank filled with stone acts as an anaerobic filter. This type gives an effluent which is nearly odorless and does not carry much suspended solids. However, this type may offer some objections in operation. The effluent from this tank can be run into an open ditch without producing a sight or smell nuisance.

The disposal of the effluent is a big problem. In several

*From 1923 report, Committee on Farm Sanitation.

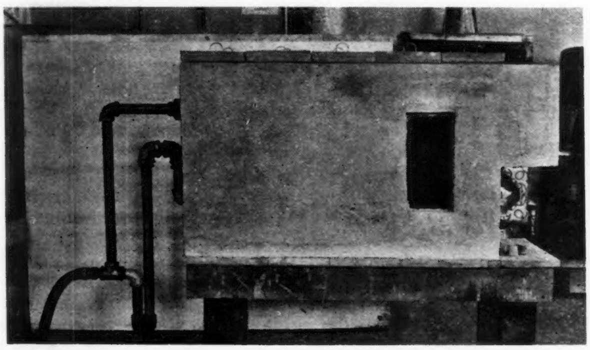


Fig. 1. An experimental septic tank used at the University of Minnesota in sewage disposal investigations.

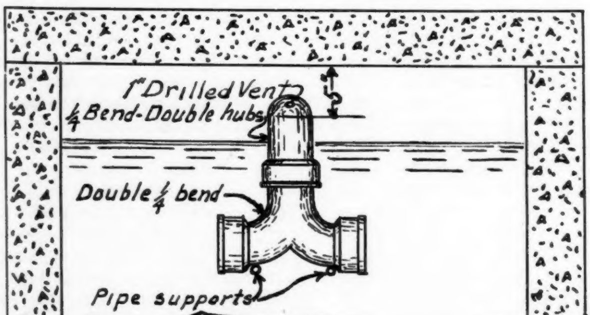



Fig. 2. The elbow and tee type of soil pipe inlet.

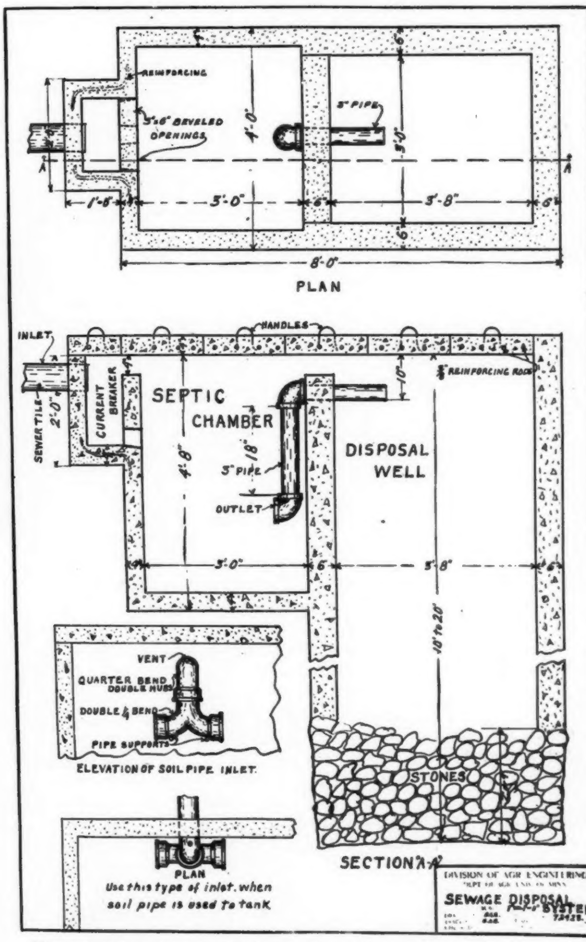



Fig. 3. This shows the type of septic tank and disposal well used in the University of Minnesota investigations.

because of high ground water. In many cases the soil is a very heavy fine-grained clay at the surface, in which subsurface disposal is not a success. In many such cases it is also impossible to use a surface disposal into a stream or into an existing tile drain. In such cases we have been using a drainage well. We now have eight of these under observation. The general type of tank and disposal well is shown in Fig. 3. So far this type appears to offer a very good solution of the disposal problem for almost any situation. One of these wells is now in use where the water level comes within two feet of the surface in the spring time. Where the soil is very finely grained clay or silt we are using the filter chamber in connection with the disposal well. Our investigations along these lines will be continued.

# Farmstead Engineering at Delhi Colony*

By Max E. Cook

Mem. A. S. A. E. Farmstead Engineer and Acting Superintendent (Delhi Colony), California State Land Settlement Board

NOTE: This is a report of the activities and progress of the department of farmstead engineering at the Delhi Colony, a project of the California State Land Settlement Board. The report includes activities up to January 1, 1924, except where otherwise noted or implied. The department of farmstead engineering at the Delhi Colony has been actively in charge of Mr. Cook from December 1, 1919, to March 17, 1924, on which date he also took over the duties of acting superintendent. Prior to this date, from May 1, 1918, to December 1, 1919, Mr. Cook was farmstead engineer at the Durham Colony. During the past six years Mr. Cook has built over a thousand farm houses and buildings on the Durham and Delhi state land settlement projects, having spent fourteen years previously as a commercial architect. He is a pioneer in the agricultural-engineering phases of land settlement work.

THE activities of the department of farmstead engineering at Delhi Colony embrace planning, designing, quantity surveying, obtaining competitive bids, letting contracts, and supervising construction of all classes of farm, townsite, and administrative buildings, and making individual farmstead layouts for all settlers, determining location and arrangement of buildings, lanes, corrals, poultry runs, domestic wells, orchards, vegetable gardens, etc. Individual settlers were given unlimited consultation in acquainting them with state housing laws, dairy laws, sanitary rules, board of health re commendations relative to sewage disposal, protection of domestic water supply, insurance rates and hazards, requirements of good practice in plumbing, electric wiring, paint formulas, concrete mixing, chimney construction, carpentry, etc. All buildings are appraised for resale and as a basis for loans, and all buildings rented were scheduled by this department.

Active interest and support is given to community development, services having been extended to school boards and the settlers' co operative association. This included preparing plans, specifications and supervision of construction of a $10,000 community hall at Delhi.

In addition, all building account creditors have been protected to insure titles and promote low costs, prospective settlers have been acquainted with local building conditions and costs, and a very substantial contribution has been made by this department to general administration by active participation in affairs not connected with the building program and by thorough co-operation with other departments.

The first building contract was awarded March 4, 1920. Since then $500,000 has been expended on building development; $380,000 of this amount was handled by this department, and $120,000 expended by settlers on buildings and accessories without our direct assistance.

Over four hundred contracts for labor and material were awarded; a certificate of satisfactory completion was signed by the settler in every instance.

Over two hundred and fifty itemized bills of material were prepared and furnished to settlers to guide them in building.

Two thousand complete sets of plans and specifications have been issued to settlers and contractors.

A total expenditure of $248,000 was made on state buildings and equities in settlers' buildings.

A total of $123,000 has been expended on state building development; this includes a $10,000 community hall since assumed by settlers.

Four hundred detailed building appraisals on $176,000 worth of construction were made to support $100,000 in loans.

The remaining $25,000 in loans is covered by fifty improvement contracts on $42,000 in buildings where the state assumed 60 per cent equity.

| Total Allotments | Developed With Buildings | Undeveloped Sold | Undeveloped Unsold |
|---|---|---|---|
| Farms ...301 | 186 | 26 | 89 |
| Two-acre. 67 | 53 | 12 | 2 |
| Totals ...368 | 239 | 38 | 91 |

There have been 750 buildings built on the settlement to date on 239 allotments and townsite.

There are 600 buildings on 186 farms costing $315,000.

The average building development per farm costs $1,700.

The 135 buildings on 53 two-acre allotments cost $62,000.

The average building development per two-acre allotment cost $1,170.

Twelve hundred separate building operations have been required since many buildings have been built in units or on the installment plan, requiring separate contracts or operations with time elapsing between same. Settlers signed their acceptances at the time of completion. This is at the rate of a building for each working day during the term.

One hundred and forty-three poultry houses representing a total investment of $45,000 with a capacity of 50,000 hens were built; if placed end to end, these houses would be over one mile long.

Seventy-five per cent of the capacity is in special standardized design at a cost of $36,000, or 96 cents per laying hen. The remainder of the houses, of varying designs, cost $1.18 per laying hen.

The digging of one hundred and forty-six domestic wells were handled by the farmstead engineering department; sixty-two 7-inch cased wells averaged 66 feet deep with 55 feet of casing, at average cost of $108.

Buildings and building equipment condemned as having no further usefulness to the state were disposed of through the farmstead engineering department; they were formally advertised for bids and sold to the high bidder. Some $2,000 was recovered in this way involving twenty-five operations.

All construction buildings designed by the farmstead engineering department were built with a view to maintaining the highest possible salvage value, and many of them were moved bodily to farms where they are now serving permanently as utility buildings in accordance with this predetermined plan.

Disregarding the substantial saving effected by careful design avoiding waste and without taking into consideration what is perhaps the largest element of saving (the influence exercised to prevent extravagance and over development), from a detailed analysis of complete records on file and by comparisons of various methods employed, a saving of 15 per cent has been effected, amounting to $57,000.

| | | |
|---|---|---|
| Total saving effected (15 per cent) | | $57,000.00 |
| Total cost of service to January, 1924 | $17,000.00 | |
| Less Farmstead Fees billed by state | 7,000.00 | |
| | | 10,000.00 |
| Net saving | | $47,000.00 |

Or in three years nine months there has been a net saving per year of $12,500.

The service has cost 2.6 per cent of $380,000 of total work handled.

# Research Methods in Agricultural Engineering

**Research activities in the agricultural-engineering field are presented under this heading by the Research Committee. Articles dealing purely with the manipulation of research methods and equipment are featured. Members are invited to discuss material presented and offer suggestions on timely topics**

## Research in Agricultural Engineering—1923*

By R. W. Trullinger

Mem. A. S. A. E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

(Continued from the May issue)

### Drainage

A vast amount of work, mostly of a service nature, has been done on the subject of drainage, and, with a few exceptions, very little work of a fundamental nature has apparently been undertaken. There is a record of nineteen projects in drainage this year at ten different experiment stations in the states of Illinois, Minnesota, Michigan, California, Mississippi, Montana, Oregon, North Carolina, Missouri, and Wisconsin. Some of these projects are quite general in nature, while others are more specific and are apparently attempting to establish standards for the spacing and depth of drains for particular conditions.

Little more than general information seems to exist as to what constitutes a well-drained soil for a particular set of conditions, including crop, climate, etc., and, with a few exceptions, a consideration of the soil, beyond rather vague empirical treatment, has rarely been undertaken in this country as a basic consideration and logical starting point in drainage studies.

Certain foreign agricultural experiment stations have taken the view that the soil and the crop to be grown are the things most vitally concerned in drainage and with this as a basis have undertaken to establish the principles governing the movement of water through soils of different physical and mechanical characteristics as a preliminary to the development of drainage methods. One study on the relation between soil properties and drainage has developed rather definite relations betwen peremability and such soil properties as clay content, calcium carbonate content, relative speed of sedimentation, specific surface, specific weight, and other lesser physical properties.

Steps in somewhat the same direction but of a more comprehensive nature are the plans at the North Carolina, Missouri, and Oregon stations to study the influence of the physical and chemical properties of the soil and of different soil treatments and crops on run-off. The work at the Wisconsin station on the drainage of peat soils has also developed into quite a fundamental study of a more or less similar nature, and involves a consideration of the subsoil as a factor in the drainage of peat. The Minnesota station is also engaged in studies of the drainage of peat soils, and the Oregon station has encountered quite a problem in its investigations on the drainage and reclamation of alkali lands. In all these instances the importance of considering the soil first has been plainly evident.

Studies conducted at a Russian experiment station on the relation between temperature, barometric pressure, rainfall, and soil moisture showed that the ground water level rises as the soil temperature increases, especially when the upper soil layers are soaked with rain water. This is taken to indicate that the effect of temperature is due to its influence upon the air pressure in the upper layers of the soil, to the condensation of water vapor in the soil, and to changes in the capillary tension of the underground water. It was concluded that the immediate movement of the soil water level due to rainfall is caused by a change in the hydrostatic pressure of the soil gases at the ground water level, especially since the rapid infiltration of atmospheric precipitation to considerable depths was found to take place only under limited and exceptional conditions.

The interesting economic study by the Minnesota station of the cost of tile drainage in relation to the value of farm lands in Minnesota is worthy of consideration. This study brings out the fact that there is a limit to the practicability of drainage improvements under certain conditions, and it is believed that drainage studies should always consider this factor.

### Irrigation

Practically every state experiment station in the irrigated West has had projects on the subject of irrigation at one time or another, and there is a record for the year of at least thirty-six projects at twelve stations in the states of Washington, Oregon, California, Arizona, New Mexico, Nevada, Utah, Colorado, Idaho, Montana, Nebraska, and Wyoming. While some of these are apparently too indefinite to lay claim to a research status, many are planned along research lines and cover almost all phases of irrigation.

Some of the works at the California, Utah, Oregon, Nevada, Montana, and Washington stations and by the U. S. Department of Agriculture have brought out the fact that the most important factor concerned, the soil, has received relatively little study in its relation to irrigation methods and practices.

For instance, soil moisture movement studies at the Washington station made in relation to methods and amounts of application of irrigation water in border experiments showed that, generally speaking, most of the moisture was held in the first four feet. Only under exceptionally heavy irrigation did the soil samples show any pronounced increase in the fifth and sixth feet. Percolation tests showed the uniformity of lateral movement and indicated that twenty-four hours is sufficient for the irrigation moisture to meet the soil moisture vertically and to move thirty-six inches horizontally.

Studies at the Utah station on the water-holding capacity of irrigated soils showed that the amount of water absorbed by the soil when in need of irrigation varied from 0.5 inches of water to one foot of said soil to 2.25 inches of water to one foot of clay loam soil. Further results showed that as a general rule soils can absorb from 0.5 to 1.5 inches of water to each foot of depth that needs moistening and that the actual capacity of a given soil depends upon its texture and structure.

Studies on the field moisture capacity and wilting point of soils at the Oregon station showed that the wilting point of soils is a valuable indicator in connection with the determination of the exact moisture content at which to irrigate. The wilting point varied more for different crops on a soil which was rather heavy in texture than on a soil of narrow moisture limits and marked the lower limit of usable water. Only the heavier classes of normal soils were capable of retaining as much as two inches of usable water in the surface acre-

*1923 report of the A. S. A. E. Committee on Agricultural Engineering Research.

foot. The coarsest soils used for irrigation retained only half an inch per foot of depth, while peat retained from three to four inches per acre-foot. The irrigation requirement was greater for soils of coarse texture and low humus content and was largely due to unavoidable waste in connection with light frequent irrigation.

Studies by the U. S. Department of Agriculture on the storage of water in soil and its utilization by spring wheat showed that on land producing a crop each year differences in cultural methods are not sufficient to cause major differences in the depth to which water is stored and from which it is recovered. Alternate fallowing and cropping resulted, on the average, in the utilization of a somewhat greater volume of soil. Available water, when present in the soil, was removed with about the same degree of frequency from each of the first four feet. These results are taken to indicate that the utilization of a large soil mass is not essential to a high yield, this depending more upon the maintenance of a constant supply of available moisture at a depth at which it can be easily obtained.

Studies at the California station on the losses of moisture from cultivated and uncultivated uncropped sandy, dense clay, silt, sandy loam, and clay loam soils containing gravel showed that the differences between the losses of moisture from cultivated and from uncultivated soils are so small as to be well within the limits of probable error. No loss of moisture by lateral movement was detected, and there was no significant difference in the distribution of moisture to a depth of twenty inches in the cultivated and uncultivated soils. These results were confirmed in the laboratory, and the studies as a whole showed that the loss of moisture from cultivated and uncultivated soils was confined almost entirely to the surface foot. Field and laboratory studies showed that the moisture lost directly by evaporation from the surface of the soil is negligible as compared to the water required for the support of a crop.

Studies at the Utah station on the effectiveness of mulches in preserving soil moisture showed that an effective mulch of one inch of straw is capable of preserving 60 per cent more moisture in the soil than is retained without mulching. Straw was the most efficient mulch material used, followed in order by hay, grass, wood shavings, and manure. It was found that an efficient mulch must consist of material which does not absorb or retain moisture readily and which forms practically no capillary system in itself. The effectiveness of mulching and cultivation increased with their depths, and the rate of evaporation from soils under mulch varied according to their moisture contents. The finer soils lost the most water. While cultivation and mulching saved moisture, the evapo-transpiration ratio was least with no mulch or cultivation.

Fall plowing preserved more moisture than spring plowing, and the results are taken to indicate that in the dry farm regions shallower cultivation is preferable to the deeper cultivation.

The Punjab (India) Department of Agriculture has devised a new method for the determination of the average diameter of a soil particle as an important preliminary consideration in determining the permeability of a particular soil for air and water. The results of studies indicate that variation in the pore space does not affect the average diameter of the particle. A slight difference up to 3 or 4 per cent in the percentage of clay in two soils materially changed the value for the average diameter when permeability was the important factor concerned. This is opposed to the results indicated by ordinary mechanical analyses and emphasizes the importance of studies of soil hydraulics.

Duty of water studies have been in operation at the Utah, California, Nevada, Oregon, Arizona, and Montana stations during the year. The work at the Utah station, which has been in operation for seven years, on sandy loam and fine sandy loam soils began with a consideration of the average permeabilities of the soils and their maximum capacities for absorbing and retaining water. On this basis the studies were extended to show the proper use of water on such crops as beets, potatoes, and alfalfa on these soils.

Studies of methods of increasing the duty of irrigation water by the Oregon station showed that the duty of water was nearly doubled by proper rotation of crops and the use of manure, and that the existence of a richer and better balanced nutrient solution in the soil resulted in a lower water requirement. The results are taken to indicate that the duty of irrigation water will vary somewhat with the season and with anything which affects the evaporation, percolation, or transpiration of soil moisture. These two sets of studies furnish ample proof of the importance of the soil as a basic factor in any study of duty of water. This point has also been brought out quite strikingly in studies on the irrigation of sugar cane at the experiment station of the Hawaiian Sugar Planters' Association and by general irrigation studies at the Universidad Nacional de La Plata. The work at the latter institution is planned to include a quite detailed preliminary study of soil hydraulics.

The loss of irrigation water by deep percolation and seepage are also closely connected with soil properties. Studies at the Montana station showed that losses of irrigation water from small grain and alfalfa soils varied from 0 to 45 per cent of the amount applied, the average loss being from 22 to 23 per cent. The losses depended upon the head, the method of irrigation, the handling of the water, and the condition of the soil. Seepage losses from laterals averaged about 30 per cent of the total amount of water entering the laterals.

Studies by the Colorado station on the return of seepage water indicated the magnitude and complexity of the problem and showed that in two large irrigation districts the ratio of the seepage return is about the same as the ratio of the gross duty of water.

The reclamation of alkali soils is closely related to irrigation, but the problem involved is largely one of soil physics and chemistry. There are at least fourteen projects on alkali soils at eight stations in the states of California, Utah, Wyoming, New Mexico, Oregon, Idaho, Arizona, and New Jersey, most of them being aimed at methods either for removing the alkalinity or reducing its effect. The work at the New Jersey stations on the use of sulphur on impervious alkali soils is quite significant in that it shows the oxidizing power of such soils for sulphur and the influence of the resultant sulphuric acid in coagulating the soil cementing colloids, thus destroying impermeability and permitting leaching operations.

The alkali investigations at the California station have also shown the neutralizing influence of sulphuric acid, gypsum, elemental sulphur, ferrous sulphate, and alum on black alkali and have indicated the value of simple leaching with and without gypsum treatment on irrigated vineyard soils. These studies have also indicated the tolerance limits of certain irrigated crops to different alkali salts.

Studies by the U. S. Department of Agriculture demonstrated the effectiveness of manure alone or in combination with gypsum, sulphur, or acid phosphate for the reclamation of alkali soils on different irrigation projects where the soil has become hard and impervious after each irrigation.

Studies at the Wellcome Tropical Research Laboratories at Khartum on the relation between the moisture equivalent of heavy soils and alkalinity showed that treatment of such soils with dilute solutions of flocculating salts such as calcium sulphate, ammonium nitrate, or ammonium sulphate reduced the moisture equivalent, while alkalis such as sodium carbonate increased it up to a certain point and then decreased it.

The U. S. Department of Agriculture and the Colorado station have been the leaders in work on the measurement of irrigation water. The studies of weirs, current meters, and Venturi flumes at the Colorado station have been productive of quite useful information. The California, Utah, Idaho, and Montana stations have also done some quite useful work on water measurement devices and methods.

Pump irrigation is also gradually increasing in importance, and work has been in progress during the year on the subject at the Nebraska, Arizona, Montana, and Utah stations.

(To be concluded in the July issue)

# What the Meetings Committee Has to Say About the Program

(Continued from page 124.)

along land-clearing lines in the state of Michigan. He is particularly well qualified to present this phase of reclamation work.

Since the last annual meeting of the Society some very interesting new developments in salvaging war explosives have been made, which will be presented by W. A. Rowland of the University of Wisconsin land clearing staff. This will be in the nature of a report of investigations being conducted by the U. S. D. A. division of agricultural engineering and the department of agricultural engineering at the University of Wisconsin.

The reports of the drainage, land clearing, land settlement, and soil erosion committees, listed on the program are important features of the reclamation program; some very interesting developments will be included in the reports to be presented.

All interested in reclamation, who will attend the Lincoln meeting and who wish to take the reclamation tour June 17 prior to the official opening of the annual meeting, should notifiy Prof. I. D. Wood, College of Agriculture, Lincoln, before June 10. A tour of southeastern Nebraska will be made where large soil saving dams, terraced fields, ditches controlled by brush dams and tile-drained fields will be visited. The tour will take the entire forenoon and part of the afternoon of June 17; the rest of the day will be devoted to a round-table discussion of reclamation at the College of Agriculture and dinner in the evening. The reclamation projects to be visited are located at Ashland, Nebraska. Automobiles will meet Burlington train No. 5 at Ashland at 9:25 A. M. Ashland is the starting point on the tour and all persons from North and East should leave Omaha on Burlington train No. 5 at 8:25 P. M. and stop at Ashland. Other cars will leave the agricultural engineering building at the College of Agriculture Campus at 8:15 A. M. to accommodate members arriving on early morning trains.

## Rural Electrification Program

By E. A. White

THE rural electrification program will reflect in a broad way the status of electric service on the farm, not only in this country but for the entire world. An entire day, June 19, will be devoted to the rural electrification program. It will be a grand summary of the farm power problem, together with a strategic planning for a campaign to outline the method of attack for determining what place electric service will ultimately occupy in agriculture.

This program will be opened with a paper by R. W. Trullinger, specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture, entitled "Some Research Features Involved in the Application of Electricity to Agriculture."

The theme of this paper will be "what to investigate and how to do it," a matter of paramount concern to all interested in this problem. This paper will be discussed by five of the leading agricultural engineers of this country.

Closely allied to this subject of investigation is R. A. Lundquist's paper entitled "Electricity in Agriculture Abroad." Mr. Lundquist has charge of the foreign rural electrification survey now being made by the U. S. Department of Commerce, and is in position to give this subject more comprehensive and exhaustive treatment than it has yet received. If there is any foreign information of value to American practice, we want to know it.

For the past year the U. S. Department of Agriculture has been at work collecting, digesting, and preparing for publication all available information relating to farm power. This is probably the first and certainly the most comprehensive attempt ever made to reduce the farm problem to an engineering basis. The big point of this work will be presented by C. D. Kinsman who has been secured by the U. S. Department of Agriculture especially for this work. Men who have been looking over the material collected pronounce this one of the most fundamental pieces of work ever attempted in relation to farm power.

There is an unusual amount of interest in agricultural circles regarding water power and its developments. G. C. Neff, of the Wisconsin River Power Company, and secretary of the Committee on the Relation of Electricity to Agriculture, will discuss "The Relation of Water Power to Electrical Development." He will not only show the importance of water power but also some things that it will and will not do.

Interesting reports by the chairman of the Committee on Unit Farm Electric Plants and the Committee on Rural Power Lines will also be features of the rural electrification program.

## Farm Structures Program

By F. W. Ives

THE farm structures program of the eighteenth annual meeting is centered around the thought of lowering the cost of production. Naturally a farm structures program cannot affect the cost of production in any rapid or tangible manner. But the idea of the program is that buildings and a more economical investment of money will resolve itself into a saving in the future. It is the ideal of every farm structures designer to effect greatest economy, convenience, and appearance in the structures that he works upon.

The paper by W. G. Ward, extension architect at the Kansas State Agricultural College, entitled "To What Extent Can Farm Houses Be Standardized," is looking toward the solution of a cheaper house problem. Prof. Ward has specialized in farm building work and is in every respect competent to handle this subject.

A paper by Erwin K. Young, a senior student in agricultural engineering at the Ohio State University, deals with the more convenient arrangement of barns and sheds. This paper has required a great amount of work with actual teams and vehicles, and the results of this study will be of intense interest to anyone interested in the more convenient arrangement of farm buildings.

The remainder of the farm structures program centers around the report of various committees of the farm structures division. With men of the standing of Kelley, Carter, Foster, Walker, Stewart and Ekblaw we have the assurance that this part of the program will not be lacking in meat.

## College Division Program

By Dan Scoates

THE College Division program for the annual meeting is without doubt the best that has ever been prepared for an A. S. A. E. meeting, and every man interested or engaged in agricultural engineering educational work should by all means plan to attend the meeting, as he will find it a most profitable experience.

The program has been given very serious consideration by the Advisory Committee of the College Division and is part of a planned program which is to extend over a number of years. So in order to get the full benefit of the work the College Division is doing, it is necessary to attend the meeting and hear the presentation of papers, reports and discussions. However, individually they stand alone and any man coming in for the first time will find things of particular interest.

It has been the purpose of the Advisory Committee to outline a program which covers well various fields that interest the educator, namely, resident teaching, research, and extension.

The College Division is doing things and the various committee reports will bring these results to the attention of those in attendance and offer an ideal opportunity to those interested to keep up to date.

# Survey of Agricultural Engineering Progress

**A review of current literature on engineering as applied to agriculture prepared monthly by Robert W. Trullinger, Mem. A. S. A. E., specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture**

**Exposure Tests on Colorless Waterproofing Materials,** D. W. Kessler. (U. S. Dept. Com., Washington, D. C., Bur. Standards Technol. Paper 248 (1924), pp. 33, pls. 3, figs. 10.) This paper describes the nature of several colorless waterproofing materials and presents the results of physical tests on the various treatments to determine their relative effectiveness and durability. The greater number of the materials tested consistd of paraffin, china wood oil, aluminum, soap, and resinous materials dissolved in light mineral solvents. These were applied to the surfaces of such porous materials as limestone and sandstone in order to render them impervious to moisture. The dissolved matter is carried into the pores of the surface, and as the solvents evaporate a considerable portion of the solid matter remains in the stone, which tends to fill or seal the pores.

The most effective waterproofing materials were found to be those the waterproofing elements of which are heavy petroleum distillates, fatty oils, or insoluble soaps. It was found that the effectiveness of any waterproofing may be greatly influenced by the character of the pores in the stone, those having close textures being more difficult to waterproof than those with large pores. The treatments giving the highest waterproofing values and which appeared to be the most durable were those using paraffin as the waterproofing element either alone or in conjunction with other materials. The deterioration or loss of waterproofing value on materials of this type was not appreciable within a period of two years.

Waterproofing materials employing resinous substances as the waterproofing element were not durable, and materials consisting of aqueous solutions, the purpose of which is to react chemically with stone or to act merely as water repellents, had only temporary effects. Separate aqueous solutions which react chemically with each other and form insoluble substances in the pores of the stone gave low waterproofing values and deteriorated rapidly. In general, those materials which gave the highest waterproofing values produced the greatest discolorations, which were proportional to the porosities of the stones. These discolorations decreased on exposure to the weather.

**Relation of Sewer Trench Width to Load on Pipe,** G. C. D. Lenth. (Engin. News—Rec., 92 (1924), No. 13, pp. 533-535, figs. 14.) Data from different sources on methods of pipe laying and the relative bearing values of the different methods are summarized, and curves showing the loads in trenches of varying widths for different kinds and conditions of soil, computed from Marston's formula, are presented.

**Radiation Characteristics of the Internal-Combustion Engine,** T. Midgley, Jr., and H. H. McCarry. (Jour. Soc. Automotive Engin., 14 (1924), No. 2, pp. 182-185, figs. 7.) Studies are reported which showed that the radiation produced during internal combustion is a function of the chemical reaction involved to a much greater extent than are merely the temperatures of the gases. It is considered entirely possible that the high radiations recorded during detonation are as much a function of gas temperatures as they are of any difference in the chemical reactions involved.

**Dairy Barn Construction,** K. E. Parks. (U. S. Department of Agriculture, Farmers' Bulletin 1342 (1923), pp. II + 22, figs. 17.) This bulletin discusses the principal features of modern dairy barn construction and equipment, and presents practical plans for various types and sizes of dairy barns.

**Mechanical Friction as Affected by the Lubricant,** L. H. Pomeroy. (Jour. Soc. Automotive Engin., 14 (1924), No. 3, pp. 307-312, figs. 2.) Studies conducted to ascertain the relation of the lubricant to the internal friction of an internal-combustion engine at various speeds are reported. The principal sources of friction in an engine are enumerated as the crankshaft, camshaft, and connecting-rod bearings in rotation; the pistons and valves which slide; and the generator, pump, and distributor.

The experimental results showed that a variation in the viscosity of the lubricant can easily account for a reduced mechanical efficiency and, consequently, for the increased consumption of gasoline, and that the friction loss is proportional to the cubic capacity of the engine. On the other hand, the brake mean effective pressure for the same horsepower is inversely proportional to the capacity.

Tabular data are given showing the variation of the friction mean effective pressure at various speeds and at various temperatures of the water and oil, and the fuel consumption of the engine at part throttle and at varying oil and water temperatures. A method of calculating the reduction of the gasoline consumption, assuming a constant indicated thermal efficiency, is also advanced.

Results as determined from friction curves and from actual tests suggest that the thermal efficiency is affected but little by the water jacket temperatures, and that the saving on account of thermostats and radiator shutters is caused almost entirely by reduction in the viscosity of the oil. While the water terperature rises very rapidly the oil temperature does not ordinarily rise more than 40 degrees Fahrenheit above atmospheric temperature and after prolonged fast operation the rise amounts to about 90 degrees. Thus to obtain a mean oil and water temperature of 170 degrees, the atmospheric temperature must be about 80 degrees at a speed of approximately 40 miles per hour, while for ordinary slower operation the conditions of maximum efficiency are not realized unless the atmospheric temperature is about 130 degrees.

In a study of methods of keeping dirt out of the crankcase, it was found that certain oils that worked well under normal conditions became too viscous in cold weather. The property of oiliness increased in importance as the bearing surfaces more nearly touched each other, and especially when the engine was starting from rest.

**Imhoff Tank and Sprinkling Filter Studies at Plainfield Works,** W. Rudolfs. (Abs. in Engin. News—Rec., 90 (1923), No. 18, pp. 779-781.) The progess results of studies conducted by the New Jersey experiment stations in cooperation with the New Jersey State Board of Health on the chemical changes in sewage and on the sewage flora and fauna are reported.

It has been found that very few fungi and algae occur in the Imhoff tank. The protozoa apparently increase in number with increasing depth and as a rule the scum formed in the vents of the tank does not contain protozoa at all. It is noted that the numbers of flagellates and ciliates in the influent are ordinarily the same as those in the effluent.

The data show further that the more abundant bacteria in Imhoff tanks are those which attack the most easily digested protein material. These bacteria were always present even in the highest dilutions used, and their numbers apparently bore some relation to the character of the protein molecule. This seemed to be indicated by the fact that bacteria which produce sulphids from soluble proteins are less prevalent than bacteria which produce ammonia from the same substances. It is noted that nitrogen is oxidized to the nitrate form, while at the same time organisms are present which reduce nitrates to nitrates, and finally to ammonia. This latter group was found to be in ascendance in the Imhoff tank. In addition to the groups of bacteria mentioned, other organisms were found which included (1) bacteria producing sulphids from inorganic sulphates, (2) bacteria oxidizing thiosulphate to free sulphur and sulphates, (3) bacteria which digest cellulose, and (4) bacteria which split fats.

Reaction studies showed that in nearly every case the scum in an Imhoff tank is decidedly less alkaline than the influent, and in nearly all cases less alkaline than the preliminary sludge, ranging in reaction from pH. 6.8 to 7.6. Bacterial action was found to cause considerable production of carbon dioxid. At the same time the sulphur organisms producing hydrogen sulphid and the sulphates present or produced by bacteria cause a reduction of alkalinity of the material. This is taken to indicate the reason why the liquid layer is usually slightly less alkaline or sometimes neutral as compared with the influent. Foaming is considered to be the result of gas production, and while organisms producing large quantities of gas may be beneficial they can be the cause of the poor operation of a tank. The total absence of oxygen and hydrogen in Imhoff tanks is considered especially noteworthy.

Studies on sprinkling filters showed that the slimy film which accumulates on the stones of sprinkling filter beds plays a very important part in the purification of the sewage which passes through the filter. This film is composed largely of a host of bacteria, a great variety of microscopic animals,

and occasionally an abundance of fungi. The film on the surface is characterized by the great predominance of algae, which are not present in great variety but are extremely abundant in quantity. As the fungi disappear there are increasing amounts of filumentoos bacteria and protozoa which help to hold the film together. It is emphasized that it is the living aggregate of associated organisms constituting the film rather than any simple type of creature which is significant for the purification of the sewage. It is noted that nitration increases rapidly after sloughing, and when the film around the stones becomes thicker nitration decreases. With the disappearance of protozoa in the natural film, nitrification improves.

**Beef Cattle Barns.** E. W. Sheets and M. A. R. Kelley. (U. S Department of Agriculture, Farmers' Bulletin 1350 (1923), pp 11-17, figs. 16.) Practical information on the planning, con struction, and equipping of beef cattle barns is presented.

**Stresses in a Few Welded and Riveted Tanks Under Hydrostatic Pressure.** A. H. Stang and T. W. Greene. (U. S. Dept. Com. Bur. Standards Technol. Paper 243 (1923), pp. 645-666, pls. 3, figs. 7.) Studies to determine the relative merits of riveted and electric welded tanks are reported, in which four steel tanks 4 feet in diameter and 10 feet long, made of $\frac{5}{16}$ inch mild steel plates, were tested under hydrostatic pressure. Two of the tanks were butt welded, one was lap welded, and the fourth was of the ordinary lap riveted construction. The ends of the tanks were spherical with a 4 foot radius. The results of the hydrostatic tests proved rather unsatisfactory for comparing the relative strengths of the different types because of secondary failures.

For thin tanks the measured stresses, based upon the two dimensional formulas for longitudinal as well as transverse stress in the tanks, were found to be in close agreement with the design stresses computed by the common pressure formulas, provided the former are not affected by secondary causes. Secondary stresses, which resulted in high stress intensity and produced failure in each case, were caused by faulty design of the attachment of the spherical end to the cylindrical shell, by nonconformity of the shell to an accurate circular section, and by discontinuities in the shell for the manhole and fittings. Stresses were increased by the presence of a seam.

Poor welding and calking were responsible for the premature failures of two of the tanks. It is concluded that with more careful workmanship these tanks can be made, having a factor of safety of two or more, for a working stress of 16,000 pounds per square inch in the plate.

**The Strength of Concrete: Its Relation to the Cement, Aggregates, and Water,** A. N. Talbot and F. E. Richart, (Illinois University, Urbana, Engineering Experiment Station Bulletin 137 (1923), pp. 118, figs. 46.) This bulletin reports studies resulting in a statement of relations between the compressive strength of concrete and the amount of the cement and voids contained therein. Methods for studying the concrete-making properties of fine and coarse aggregates and for the comparison and acceptance of aggregates are developed, and means for designing concrete mixtures for different densities and strengths are outlined. Means are suggested for estimating the effect upon the strength and density of concrete which accompanies an increase in the amount of mixing water beyond that which would give minimum volume.

A large amount of data is included.

**Winter Tests Show Greater Dilution With Heavy Fuels,** J. A. C. Warner (Jour. Soc. Automotive Engin., 14 (1924), No. 2, pp. 151-161, figs. 10). In a contribution from the U. S. Bureau of Standards the results of analyses of fresh crankcase oils and the dilution results are presented, and a comparison is made of those obtained under summer with those obtained under winter conditions from a large number of cars and trucks.

The winter tests showed a slight increase in average fuel consumption for an increase of 55 degrees Farenheit in the 90 per cent point of the distillation curves. This difference in economy is considered to be unimportant when compared with the estimated difference in the possible production of fuels of two extreme volatilities from a given quantity of crude oil. The more volatile fuels were superior as regards starting and general performance, and preference corresponded to the relative volatility arrangement between the 14 and 20 per cent points of the distillation curves.

The less volatile fuels gave the greater dilution and similar fuels gave greater dilution in winter than in summer. Within the mileage range covered by the tests, dilution appeared to reach an approximate equilibrium after comparatively short runs. Actual crankcase oil consumption for all the tests averaged the equivalent of 476 miles per gallon.

A report of a series of parallel runs with a commercial gasoline and a special winter fuel is appended.

**Control of Detonation,** G. A. Young and J. H. Holloway. (Jour. Soc. Automotive Engin., 14 (1924), No. 3, pp. 315-318.) Studies conducted at the Purdue University engineering experiment station on methods of controlling the temperature of the charge before and after the mixture enters the combustion chamber and before normal ignition occurs in an internal-combustion engine are reported. Previous tests made on a poppet valve engine and on a sleeve valve engine revealed the impracticability of applying the laboratory methods used at that time to commercial practice, and the need of eliminating difficulties inherent in those methods of detonation control. The various changes made in the engine are described, including the special design of spark plugs.

The conclusions drawn in tests covering a period of two years are that when reasonable care is exercised in maintaining the mixture, the spark plugs, the valves, and the combustion chamber at the proper temperature, a compression pressure of 125 pounds per square inch can be used without detonation by the addition of a small amount of anti-knock compound to the fuel with enough increase in the efficiency of the engine to warrant the additional expense. All the commercial spark plugs used were found to be the first cause of detonation. Spark plugs could be designed and built which would operate at a temperature low enough not to produce detonation and yet be practical.

**International Critical Tables of Numerical Data of Physics, Chemistry, and Technology.** (Washington, D. C., Natl. Research Council (1924), pp. 15.) Tables of fundamental constants and conversion factors prepared under the auspices of the International Research Council are given.

**Ust of Machinery in Ditch Digging and Experiments in Drainage Ditching and Reclamation,** O. Fredholm, Meddelanden fran Kung. Lantbruksstyrelsen, Nykoping (Sweden), No. 248 (1924), pp. 94, figs. 74.) Observations on machine ditching in large-scale drainage operations made during a tour of the United States, England, Germany, and Holland in the year 1922 are presented, and types of ditching machines adapted to Swedish conditions are enumerated. The advantage of electric power for the operation of ditching machines is emphasized. Internal-combustion engine driven machines gave better results than steam engine driven machines, owing to the ease of handling and storage of the fuel, but repairs were more difficult to make.

**Dust Explosion Control Difficult,** H. W. Frevert (Iowa Engineer. 24 (1924), No. 6, pp. 5, 6, 26, fig. 1.) In a contribution from the Bureau of Chemistry, U. S. D. A., a summary is given of work conducted by the Department and other agencies on dust explosion control. It is pointed out that dust explosions and their causes are extremely hard to investigate because the force of the explosions destroys everything in th path, and because the widely varying dust mixtures which may cause the explosions are hard to keep in suspension for laboratory study.

**Slip, Friction and Stretch Tests for Leather Belting,** L. C. Morrow. (American Machinist, New York, 60 (1924), No. 13, pp. 469-471, figs. 8.) Information on methods of testing leather belting for slip, stretch, and frictional characteristics is presented. An example of an overloaded belt running without tension on the slack side is described.

**The Development and Future of Electric Milking in New Zealand, L. Birks.** (New Zealand Journal Science and Technology, Wellington, 5 (1922), No. 5, pp. 250-258, fig. 1.) Data on the development of electric milking in New Zealand are briefly presented and discussed. It is stated that the history of the development of electric power milking has been the replacement of the standard 3 horsepower oil engine, driving the ordinary releaser milking machines, by a 3 horsepower electric motor. This amount of power was found to be largely in excess of that actually required, and even 1 horsepower operated sufficient milking machines to deal with a herd of a hundred cows. Since a large proportion of the herds range from ten to twenty cows, a plant capable of milking two cows at a time is all that is required. The final development is a compact type of machine capable of fulfilling this service and driven by a motor of only 0.25 horsepower.

## Book Review

**House Plans.** A new house plan book is being issued by the Portland Cement Association to replace the initial book, "Concrete Houses," published last year. The new book will illustrate and describe forty different designs intended to be constructed of concrete blocks with Portland cement stucco. These designs have been prepared by more than thirty prominent architects from the Atlantic to the Pacific. Several plans appropriate for farm dwellings are included in the book. In addition to showing plans for houses, the new book describes methods of concrete masonry construction, the use of stucco, and discusses fully various concrete building units, such as concrete blocks, bricks, structural tile and roofing tile. Working drawings and specifications covering all the plans in the book will be available at nominal cost through the Portland Cement Association, 111 West Washington Street, Chicago, Illinois. The price of the book is 50 cents.

# A. S. A. E. and Related Engineering Activities

## A. S. A. E. Election Results

The ballot for officers of the American Society of Agricultural Engineers to take office immediately following the annual meeting of the Society in June and to continue for the period ending June 1925, resulted in the election of the following:

President: F. W. Ives, professor of agricultural engineering, Ohio State University.

First Vice-President: H. B. Walker, professor of agricultural engineering, Kansas State Agricultural College.

Second Vice-President: W. A. Foster, professor of agricultural engineering, University of Georgia.

Treasurer: Raymond Olney.

Member of the Council: R. W. Trullinger, specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture.

Nominating Committee: G. W. Iverson, advertising manager, Advance-Rumely Thresher Company, chairman; G. W. McCuen, professor of agricultural engineering, Ohio State University; C. E Sietz. professor of agricultural engineering, Virginia Polytechnic Institute.

The ballot for the two members of the Advisory Committee of the College Division of the Society to succeed O. W. Sjogren and C. O. Reed, whose terms expire in June, resulted as follows: L. J. Fletcher, professor of agricultural engineering, University of California; R. U. Blasingame, professor of farm machinery, Pennsylvania State College.

As a result of this ballot, the personnel of the Executive Council of the Society for the year following the annual meeting in June, with the exception of one member to be appointed by the Council to fill the unexpired term of F. W. Ives, who was elected member of the Council last year, will be as follows. F. W. Ives, president; H. B. Walker, first vice-president; W. A. Foster, second vice-president; R. W. Trullinger; William Aitkenhead; S. H. McCrory; E. W. Lehmann and Raymond Olney, treasurer.

## Personals

**Ray W. Carpenter**, professor of agricultural engineering, University of Maryland, is the author of a new bulletin entitled "Cutting Production Costs with Farm Machinery" (Bulletin No. 33) just issued by the extension service of the University of Maryland.

**Max E. Cook**, farmstead engineer of the Delhi Colony of California Land Settlement Board, was recently made acting superintendent of the colony. He will continue to act in the capacity of farmstead engineer and has declined the appointment of permanent superintendent of the colony in order that he may devote his efforts exclusively to farm buildings and farmstead planning. Mr. Cook has been farmstead engineer for the past six years at the Delhi Land Colony.

**Truman E. Hienton**, formerly extension agricultural engineer at the Iowa State College, is now extension rural engineer at Purdue University, Lafayette, Indiana.

**A. T. Logan**, manager of the ventilation department of the James Manufacturing Company, has recently been elected vice-president of the company. He will still continue as manager of the ventilation department.

**C. O. Reed**, in charge of farm field machinery work at Ohio State University, is a member of the special teaching faculty at the National Summer School to be held at the Utah Agricultural College beginning June 9. The "Journal of Education" says of this summer school' "The National Summer School, to be conducted at the Utah Agricultural College in 1924, is the most elaborate program, scholastic and professional, that has ever been presented at any educational institution between Chicago and California."

## Fireproof Paint

Agricultural engineers, particularly those specializing in farm structures, will be interested in the tests the U. S. Bureau of Standards is making of the Burnot fireproofing paint. The manufacturers of this paint claims for it, which, if supported by tests and experience, will overcome a large part of the opposition to the use of lumber in places exposed to the initial sources of ignition, such as burning papers, cinders, or brands, cigars and cigarette butts, gas jets, burning kerosene, gasoline, or alcohol, electric short circuits, and other minor fire beginnings which are the cause of 90 per cent of all fires in buildings.

## Wants Data on Subsoil Plowing

(Continued from page 129.)

of Agricultural Engineering answer this question? I could get no satisfactory information from three of the leading agricultural colleges.

Stanley F. Morse

Mem. A. S. A. E.
Consulting Agricultural Engineer

Editor's Note: Members of the A. S. A. E and others, who have data on results and cost figures of subsoil plowing are requested to make it available not only for Mr. Morse's benefit, but for other members of the Society who may possibly be in need of the same information. It is also requested that such data and information be sent direct to the Secretary in order that it may be made available through the columns of Agricultural Engineering to all members, as well as Mr. Morse. The American Society of Agricultural Engineers is the central clearing house for information of this sort and, through the agency of Agricultural Engineering, is in position to render members and others a distinct service in all matters of a similar nature; in other words, put your problems up to the Secretary and he will assist you in getting the data and other help you need.

## Experiments in Plowing Cut Over Land

(Continued from page 127.)

idle time, but wheel tractors have an advantage in the comfort of riding for the operator. The advantage of time saving by tracklaying types of tractors does not apparently have very much effect on the final cost per acre.

7. It is doubtful economy to spend more than the time necessary to plow down the tops of the biggest knolls before breaking the land. By breaking with the least amount of cutting of the tops of the cradle knolls there is less subsoil brought to the surface. Levelling after breaking mixes mostly top soil and leaves few areas with only subsoil exposed.

Four tractors, two of the tracklaying type and two of the wheel type of different sizes, and a team, and seven types and sizes of plows were used in this test. The complete data as soon as available will be worked into a detailed report on each type of equipment and each plot.

While this test was conducted on rough hardwood land consisting of medium heavy loam, the conclusions will in general apply to the conditions met by the average settler or farmer in these districts, with the exception of the areas of red clay and in swamps or muckly land. It is intended to conduct similar tests on areas of red clay lands during 1924.

## New A. S. A. E. Members

**John N. Arndt,** investigator in grain dockage, U. S. Department of Agriculture, 3600 First Avenue South, Minneapolis, Minnesota.

**Addison G. Bissell,** general engineer, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pennsylvania.

**William A. Burrell,** division sales managêr, Central Illinois Public Service Company, Canton, Illinois.

**William Oliver Dunn,** commercial manager, Illinois Power & Light Corporation, 3725 North Broadway, St. Louis, Missouri.

**Hal B. Fullerton,** director of agriculture, Long Island Railroad Company, Medford, Long Island, New York.

**Claude D. SeCheverall,** assistant to president, Central Power Company, Grand Island, Nebraska.

**George S. Williams,** general superintendent, Central Maine Power Company, Augusta, Maine.

TRANSFER OF GRADE

**Everette C. Easter,** department of agriculture engineering, Alabama Polytechnic Institute, Auburn Alabama. (From Associate to Member.)

**James B. Kelley,** department of agricultural engineering, University of Kentucky, Lexington, Kentucky. (From Junior to Member.)

**A. T. Logan,** manager ventilation department, James Manufacturing Company, Fort Atkinson, Wisconsin. ( From Associate to Member.)

**George E. Martin,** practicing agricultural engineer, South Side Development Company, College Station, Texas. (From Student to Associate Member.)

## Applicants for Membership

**J .H. Boggs,** in charge of operation of the electrical department, of Missouri Gas and Electric Service Company, Richmond, Missouri.

**William Draper Brinckloe,** architect and author, Easton, Maryland.

**John Nelson Cadby,** executive secretary, Wisconsin Utilities Association, 445 Washington Building, Madison, Wisconsin.

**Edward Claude Curtis,** engineer, Kansas Gas and Electric Company, Wichita, Kansas.

**Fred S. Dewey,** vice-president, Kansas City Power & Light Company, 1330 Grand Avenue, Kansas City, Missouri.

**C. O. Dunton,** manager commercial department, Central Illinois Public Service Company, Springfield, Illinois.

**Wellesley C. Harrington,** field engineer, Portland Association, 318 Westcott Street, Syracuse, New York.

**Charles Roy Higson,** assistant to general superintendent, Utah Power and Light Company, Salt Lake City.

**William Henry Horton, Jr.,** distribution manager, West Penn Power Company, Box 1223, Pittsburg, Pennsylvania.

**Nicholas A. Kessler,** specialist in agricultural engineering,Northeastern Michigan Development Bureau, Bay City, Michigan.

**Lewis Ankeny McArthur,** vice-president and general manager, Pacific Power & Light Company, Gasco Building, Portland, Oregon.

**John F. McCarthy,** farm line salesman, Central Illinois Public Service Company, Springfield, Illinois.

**F. L. Peterson,** agricultural and sales promotion engineer, the Holt Manufacturing Company, 131t Hillcres Peoria, Illinois.

**Anastasio L. Teodoro,** department of rural engineering, University of the Philippines, Los Banos. Philippine Islands.

TRANSFER OF GRADE

**Harold T. Barr,** instructor in agricultural engineering, University of Arkansas, Fayettville, Arkansas.

**Arthur Lewis Burras,** North Fairfield, Ohio.

**Samuel Patterson Lyle,** head of department of agricultural engineering, State Agricultural School, Jonesboro, Arkansas.

**Leon George Samsel,** Kenesaw, Nebraska.



## Members' Exchange

FOR SALE: One new Keuffle & Esser blueprint frame 36 by 48 inches. Catalog No. 2463-L. Never been used. Write Agricultural Engineering Department, Experiment Station, Lexington, Kentucky, for further information.